Energy management in the industry sector: A dynamic tool for energy saving and cost reduction

by Thomas Filippou and Savvas Louizidis*, April 2010

It is widely acknowledged that industry is one of the most important sectors of any state economy, contributing to its strategy for national development and security. Even though important technological improvements have been achieved in the production processes, still a profound characteristic of industrial activity is its gross energy consumption, which in many cases is liable for product costs and eventually competitiveness.

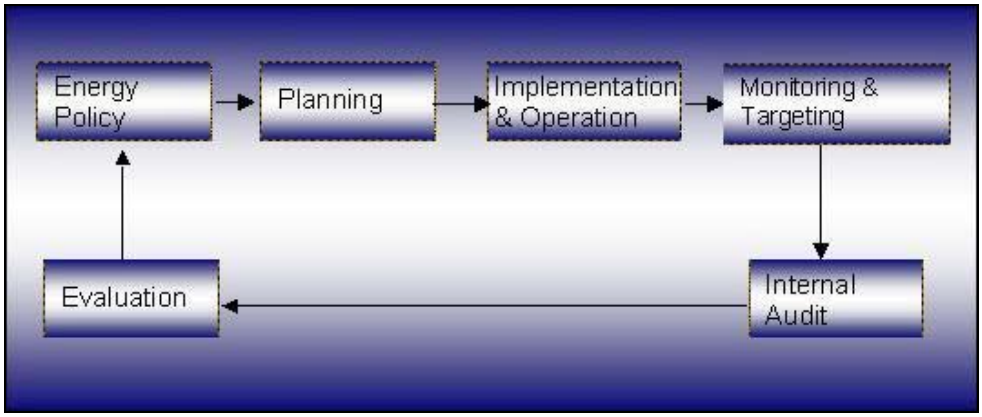
Enormous amounts of energy are consumed in the industrial sector world-wide, leading to the increase of production costs and emissions of pollutants. Therefore, control and minimisation of energy consumption in production processes are considered of major importance within modern industrial management. This aspect could even constitute the critical parameter for many industries determining either their survival or diminishment/even closure. In this frame, industrial Energy Management Systems (EMSs) is an important tool towards energy saving and cost reduction.

Before commenting on the benefits of such a system, a definition of the terms “energy management” and “Energy management system (EMS)” is necessary. Energy management refers to the implementation of organisational and technical measures in a financially sustainable way, aiming to reduce energy consumption, (including the energy consumed for the final products), along with assuring the sustainability of results in the long-term. Consequently, energy management should be regarded as a distinct corporate function, which intervenes both in the production process and in the general procedures under which the company operates. Therefore, both implementation and budgeting of energy management actions must be included in the corporate operational flow chart of a company, whereas their appropriate prioritisation is equally important.

The implementation of an EMS requires the existence –or the set up in some cases– of particular basic structures that shall comprise the foundations of system development; at the same time, the commitment of the corporate administration to the system’s implementation is essential. It has to be noted that the latter is crucial, since all decisions taken within energy management have to be imminently applicable by all involved parties, so as to maximise the expected results.

A standard industry that implements an EMS may expect an improvement of its energy efficiency by 10% to 15% during the first years of its operation [1]. Available international case studies confirm energy efficiency improvement of 20% to 25%, through implementing a variety of measures in respect to the type of industry and the particularities of its function [2].

EMSs are based on a Plan-Do-Check-Act model, which is found in any existing certification scheme, like ISO 14004 and ISO 9001, or EN 16001 (see figure below [3]).



In particular, the main stages of an EMS refer to the gradual development of an integrated frame of processes, which include interventions both to company human resources and to corporate infrastructure (e.g. equipment). This approach is defined through five main and distinct phases, analysed hereto [6]:

1. Definition of energy policy

Developing an internal corporate energy policy is essential for an efficient energy management scheme. This policy shall define particular tasks, make provision for the incorporation of the energy management team into the corporate organisational structure, ensure the continuous support by the company administration, and include a commitment for constant improvement of corporate energy efficiency. The energy policy has to be diffused into as many levels within the company as possible, and be constantly renewed.

2. Planning

Planning is an important part of any EMS, since it aims at both defining the energy saving actions and ensuring the sustainability of the programme through continuous review and proper adjustments of tasks and approaches in respect to the efficiency of actions taken. Planning shall include:

- the mapping and quantification of past and existing energy consumption situation,
- the identification of processes, operations or any sub-systems that have an significant energy consumption,
- the identification of energy saving potential,
- the definition of energy saving targets,

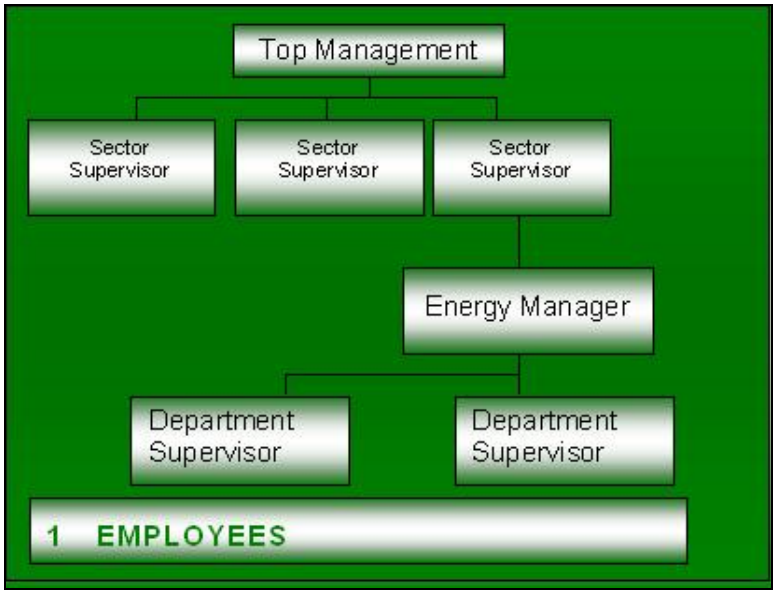
- the elaboration of an energy saving action plan, mainly comprising zero- or low-cost measures.

It also includes supplementary activities, such as capacity building planning, which incorporates training actions for the improvement of the staff's educational level, or reporting planning, which provides for a strategy concerning energy consumption reporting.

3. Implementation and operation

EMS implementation and operation actually comprises the launching of the system both in organisational and technical level, utilising means and tools that will be analysed in a following section. Main stages of this process include:

- the guarantee by the administration of available resources for the implementation and operation of the EMS ,
- the definition and identification of all roles and competencies, including the appointment of an energy manager with adequate qualifications and responsibilities.



A standard organisational chart with a proposed energy manager position shall provide for:

- periodic information diffusion to all corporate levels in respect to the implementation of the EMS,
- definition of training and educational requirements of the personnel, especially of those involved with any energy consuming activity or energy management issues,
- implementation of a codification and recording system for the EMS,

- definition and implementation of operation and process control towards energy saving in issues including equipment operation and maintenance, or procurement of new equipment and services.

Furthermore, the organisational chart may also include the operation of an existing energy saving system in order to validate its performance.

4. Monitoring and control

This process includes [3]:

- the continuous monitoring and reporting of energy consumption by appropriate specialised equipment (see also below),
- the analysis of data and the dissemination of results through standard pre-defined report forms; in this frame short-term energy audits in important sections can also be conducted,
- the monitoring of progress with respect to tasks set previously by the planning process,
- the investigation of failures and the implementation of a corrective action plan and a preventive control scheme,
- the implementation of internal audits from an independent body, aiming at verifying the EMS efficiency.

It is worth mentioning that through the above process an energy consumption registry is created. This can be used as an integrated data set for further analyses and comparisons. Both this process and the equipment required (measurement / monitoring / analysis) are considered to be one of the most important assets of an EMS implementation.

5. Evaluation

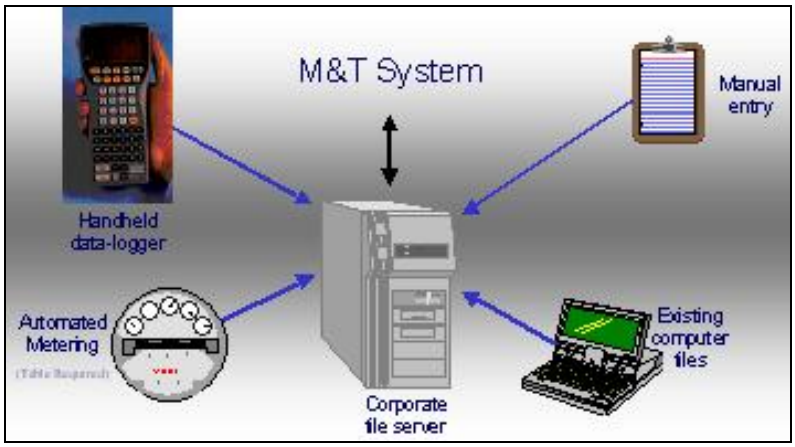
The final implementation stage of an EMS is its evaluation. In this stage the EMS implementation results are evaluated by the administration in defined time intervals, (usually on an annual basis), and corrective actions of energy policy modifications are decided [3].

Optimum energy management action planning is in any case concluded with respect to the type, size, energy consumption, and existing practices of each company, through specialised analysis and by customised questionnaires formulated for this task. In general though, it has to be noted that in order to maximise the potential benefits, the implementation of an integrated EMS is usually suggested. Such a system comprises organisational measures, as mentioned previously, along with the use of monitoring and targeting (M&T) systems.

An M&T system has the following main functions [5]:

- it measures all direct or indirect factors involved directly or indirectly with energy consumption, in particular time periods (e.g. power, temperature, pressure, flow etc.),
- it correlates such factors (mainly for energy consumption) with production rates, so as to create a base data set,
- it sets tasks for energy consumption reduction,
- it enables continuous monitoring of targets achievement,
- it reports all irregular fluctuations of energy consumption,
- it proposes actions for the elimination of such fluctuations.

A modern M&T system is also supported by a computational system of appropriate structure, so as to accept information from multiple sources and conduct data fusion. Its output, derived either automatically or manually (energy manager & respective staff), is a set of useful and processed data, to be used for the evaluation of targets attainment and further verification of the efficiency of the whole system. The following figure presents the input sources for such a computational scheme, which is included in every modern M&T system.



The scope of the present article is not to analyse the technical specifications of the software or metering requirements of such a system; it is important though to define the main factors that affect the selection of an IT system, in terms of performance, lifetime, and its flexibility to incorporate new technologies, software and sensors. Thus, particular attention has to be given to issues such as [5]:

- expandability / ease of programming,
- user friendliness,
- sensors' accuracy and maximisation of sampling points,
- analysis and design potential,
- intercommunication and data interchange potential with other systems.

It is acknowledged though, that the complexity of an integrated EMS requires the proper guidance and know-how transfer by specialised consultants, so as to be implemented efficiently. Requirements differ among various types of industry, in respect both to the final products and the production conditions. Therefore, it is necessary to adjust each solution to the particularities of each site and production process, optimising in this manner the provided results.

The continuous expansion of EMS implementation internationally is testified by the fact that even since the beginning of the current decade, established energy management standards are to be found in many countries:

Europe	EN 16001, Energy management systems – Requirements with guidance for use (draft published, Feb. 2008)
Denmark	DS 2403:2001, Energy management – Specifications
Sweden	SS 62 77 50:2003 Energy management Systems – Specification
Germany	VDI 4602 Richtlinie, Energiemanagement – Definition, Begriffe
Ireland	I.S. 393:2005, Energy management systems – Technical guideline and Energy management systems – requirements with guidance for use)
Netherlands	Energy management system – Specification with guidance for use, 2004, SenterNovem

ISO 50001 – International standard on energy management, is still under development and is expected to be established at the end of 2010 [4].

LDK Consultants' energy business unit has been active on energy efficiency since the late '70s and has developed significant expertise in energy conservation in the industrial and the building sector, including EMSs having participating in a variety of projects world-wide. Indicative references include the elaboration of training seminars on EMS for industry in Serbia in 2005, funded by the World Bank, as well as the currently elaborated European Bank for Reconstruction and Development (EBRD) programme for energy saving in the corporate sector in the NIS (2009-2012). In that context LDK provides services ranging from evaluation of the existing –if any- energy management to the design of integrated systems, provision of respective training and support for the implementation of energy saving actions. In particular, provided services include:

- the identification of investment opportunities for energy saving in industry through energy audits,
- the elaboration of feasibility studies for the implementation of energy saving measures and provision of assistance for the setting up of financing mechanisms,

- the definition of requirements and the development of integrated energy management systems, along with the training of energy managers,
- the provision of support for the implementation of energy saving investments both at engineering and at management level,
- the provision of support for the evaluation of opportunities for participating in the emissions trading scheme, along with the scheme accession process.

Today, the cost of energy is constantly increasing affecting corporate profitability. In this aspect the benefits of energy saving in various production processes by minimisation of consumption are profound. Energy management constitutes a successful and proficient approach that can be also associated with environmental compliance requirements, e.g. emissions abatement. As an example, the waste management system can be expanded to include their utilisation in a waste-to-energy scheme, so as to achieve further energy efficiency.

As an overall conclusion, EMSs that combine integrated interventions both at technical and management level constitute a power tool that has the potential through proper use and continuous improvement to provide significant benefits in terms of energy savings. The implementation of such systems is expected to expand with a rapid pace in the forthcoming period. In any case, the solid commitment of corporate administration is a key component, through a targeted energy policy along with continuous monitoring and constant improvement.

** Thomas Filippou is Energy Engineer MSc at LDK Consultants and Savvas Louizidis is Chemical Engineer MSc at LDK Consultants.*

Referernces

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[4]: International Organisation for Standardisation, Draft Version ISO 50001 (February 2008)

[5]: PESI, Energy Management Systems a Practical guide, 1997

[6]: NOVEM, Energy Management Checklist, June 2004